## REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 27-36 and 42-51 are in this case. Claims 33 and 48 were withdrawn by the Examiner from consideration as drawn to a non-elected species of the invention. Claims 27-32, 34-36, 42-47 and 49-51 have been rejected under § 103(a). Independent claims 27 and 42 have now been amended.

### Claim Objections

The Examiner has objected to the omission of the indefinite article "an" in the preamble of independent claims 27 and 42.

The Applicant has now amended independent claims 27 and 42 in accordance with the Examiner's request. The Applicant believes that the claims are now free from the irregularities identified by the Examiner.

### § 103(a) Rejections

The Examiner has rejected claims 27-32, 34-36, 42-47 and 49-51 under § 103(a) as being unpatentable over Yegnanarayanan et al. (US 2003/0142943) in view of Clap et al. ("Stimulated Raman scattering in silicon waveguides", Electronic Letters, vol. 38, Oct. 24, 2002, pp. 1352-1354). The Examiner's rejections are respectfully traversed.

Yegnanarayanan et al. teaches a silicon based optical modulator, and does not relate in any way to optical amplification. Yegnanarayanan et al. discloses doping of the silicon with gold or platinum to eliminate minority charge carriers.

The Clap et al. reference is disclosed on page 1 of the present application as an example of a non-linear process which can produce gain in silicon. Clap et al.

discloses the use of stimulated Raman scattering which is based on non-elastic interactions of photons with atoms in the silicon. It is a specific feature of the stimulated Raman scattering approach that energy absorption by electron energy level transmissions should be avoided, and hence wavelengths are chosen that are far from the absorption resonances. Clap et al. explicitly state (page 1353, col. 1, lines 17-21):

> This work focuses on the amplification of signals in the C-band of optical-communication networks, centred at 1540 nm, using first-order Raman scattering in silicon. The corresponding pump wavelength, of 1427 nm, is far from any absorption resonances (at 360 nm-direct transition and 1130 nm-indirect transition).

Thus, the signal and pump wavelengths of Clap et al. are chosen to <u>avoid</u> wavelengths corresponding to electron energy level transitions, and hence no population inversion is achieved.

In contrast, the present invention relates to optical amplification in an indirect-gap semiconductor such as silicon by a completely different mechanism from that of Clap et al., namely, by stimulated emission through population inversion. Thus, as explicitly recited in independent claim 27 as before the examiner, the method of the present invention amplifies an optical signal within a target region, where the <u>optical signal is of a given wavelength corresponding to an energy transition</u>, and more specifically, an energy transition enabled by the claimed doping of the indirect-gap semiconductor. This choice of wavelength corresponding to an energy transition within the semiconductor is both explicitly contrary to the teachings of Clap et al. and is inherently unsuitable for achieving stimulated Raman scattering amplification. Similarly, the step of irradiating and the corresponding irradiating arrangement are implemented in such a manner as to generate population inversion in the charge carriers of the semiconductor, a condition necessary for the stimulated emission of the

present invention and inappropriate for the Raman scattering amplification of Clap et al.

Thus, in summary, the Applicant respectfully submits that:

- The Yegnanarayanan et al. reference does not teach any method or system for achieving amplification, and is therefore of no particular relevance to the present invention. Yegnanarayanan et al. merely illustrates that it is known in other contexts to dope silicon with gold or platinum, a fact which is not disputed by the Applicant.
- The Clap et al. reference does not disclose, and in fact teaches against, amplification of an <u>optical signal of a wavelength corresponding to an energy transition within the indirect-gap semiconductor</u>.
- Any attempt to modify Clap et al. by doping the semiconductor according to the teachings of Yegnanarayanan et al. would not lead a person having ordinary skill in the art to the presently claimed invention. Specifically, since Clap et al. explicitly teach that absorption resonance wavelengths should be avoided (as required by the stimulated Raman scattering technique), a person having ordinary skill in the art who wished to implement Clap et al. with additional doping would choose a signal wavelength which avoided absorption resonance wavelengths added by the doping.

While continuing to traverse the Examiner's rejections, the Applicant has, in order to expedite the prosecution, chosen to amend independent claim 27 in order to clarify and emphasize the crucial distinctions between the device of the present invention and the devices of the Yegnanarayanan et al.and Clap et al. patents cited by the Examiner. Specifically, independent claim 27 has been amended to clarify that the

step of "irradiating" is performed "*with optical illumination of a wavelength shorter than said given wavelength <u>in such a manner as to cause population inversion of charge carriers within the target region</u>, thereby causing amplification of an optical signal of said given wavelength within said target region.*"

Similarly, independent apparatus claim 42 has been amended taking care to render the corresponding features as structural definitions of the "irradiating arrangement." Specifically, claim 42 now recites that the irradiating arrangement is "*configured to generate optical illumination of a wavelength shorter than said given wavelength and deployed for irradiating a target region of said body of semiconductor with said optical illumination <u>in such a manner as to generate population inversion of charge carriers within the target region</u>, thereby causing amplification of an optical signal of said given wavelength within said target region.*"

Support for these amendments can be found in the specification. Specifically, support for the irradiation being implemented in such a manner as to generate population inversion of charge carriers within the target region can be found for example on page 14, lines 7-8.

Amended independent claims 27 and 42 now feature language which makes it absolutely clear that the device and method of the present invention implement generation of optical illumination of a wavelength shorter than said given wavelength and deployed for irradiating a target region of said body of semiconductor with said optical illumination <u>in such a manner as to generate population inversion of electrons within the target region</u>, thereby causing amplification of an optical signal of said given wavelength within said target region. The Applicant believes that the amendment of the claims completely overcomes the Examiner's rejections on § 103(a) grounds.

**Additional Claim Amendments**

On reviewing the claims, the Applicant has noted that the original language which recited a step of "directing an optical signal" or an "optical arrangement for directing..." was inadvertently overly limiting. Specifically, as explicit throughout the application (for example, on page 25 first paragraph), the amplification effects of the present invention may be used either for signal amplification or as a basis for a laser. However, the original claim language of "directing an optical signal" could arguably be considered inappropriate to various laser designs where the excitation originates within the laser block without requiring external injection of a signal.

In order to address this issue, independent claims 27 and 42 have now been amended to refer to the amplification of the given wavelength as defined by the function and structure of the irradiation arrangement, without requiring separate optics for introducing a signal.

In view of the above amendments and remarks, the Applicant respectfully submits that the invention as claimed is clearly neither taught nor in any way suggested by the Yegnanarayanan et al. or Clap et al. references, considered alone or in combination. Reconsideration of the Examiner's rejections under § 103(a), and allowance of the claims, is respectfully and sincerely solicited.

Respectfully submitted,

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